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Embracing Global Warmth: Climate Resilience in all Policies

The conclusion that human industrial activities are contributing to major shifts in global climate patterns is supported by an overwhelming amount of credible science.[1] The intense international participation and media coverage garnered by events like the 2018 Global Climate Action Summit hosted by California Governor Jerry Brown highlight the level of concern surrounding climate change.[2] However, legitimizing international collaboration on climate change remains a daunting challenge that is stalling urgently needed action to prevent abrupt change in global climate patterns. This challenge must be overcome to protect vulnerable populations and infrastructure from the inadvertent impacts of climate change that are already happening. It is increasingly clear that climate change will impact, to various extents, all societal sectors in all parts of the inhabited world.

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1. Major scientific advances on the science of climate change are documented through collaborative effort of hundreds of scientists who produce the United Nation's assessment reports under the framework convention on climate change. The Fifth Assessment Report of the IPCC was published in 2014. The sixth report will be published in 2022. More than 800 international scientists contributed to the report of Working Group I which focused on the physical science basis of climate change. *See* UNITED NATIONS IPCC, THE FIFTH ASSESSMENT REPORT OF THE IPCC (2014), https://perma.cc/LA6P-GWSR; *see also* UNITED NATIONS IPCC, ANNEX V: CONTRIBUTORS TO THE IPCC WGI FIFTH ASSESSMENT REPORT (2014), https://perma.cc/X62E-ADF9 (last visited Oct. 29, 2018); UNITED NATIONS IPCC, ANNEX V: CONTRIBUTORS TO THE IPCC WGI FIFTH ASSESSMENT REPORT (2014), https://perma.cc/X62E-ADF9 (last visited Oct. 29, 2018).

2. The Global Climate Action Summit, hosted by California governor Jerry Brown was held in San Francisco, California during 12–14 September 2018 to bring leaders and people together from various parts of the world who are committed to "Take Ambition to the Next Level." The summit aimed to broker deeper worldwide commitments necessary to accelerate action from countries to reverse the already noticeable damage due to climate change. *See* GLOBAL CLIMATE ACTION SUMMIT, https://perma.cc/J42K-ZZKJ (last visited Oct. 8, 2018).

The award of the 2018 Nobel Prize in Economics to William Nordhaus of Yale University for his work on the economics of climate change highlights the progress already made to develop tools for managing the global climate, while also revealing the gaps in legitimizing innovative ideas needed to protect vulnerable populations from the adverse impacts of abrupt climate change.[3] It is perhaps time to advocate a new framework for "Climate Resilience in all Policies."[4] However, inherently controversial trade-offs belabor salient and credible concerns for environmental quality, human health, resource conservation and climate change that complicate easy recommendations for climate resilience.

Here, I explore cases where toxic or otherwise hazardous substances are exempt from green chemistry legislation such as California's Safer Consumer Products law[5] because those substances are perceived to be necessary for mitigating climate change. Such policy discords are typically supported with arguments based on comparative life cycle assessments

3. William D. Nordhaus, Sterling Professor of Economics at Yale University was awarded the 2018 Sveriges Riksbank Prize in Economic Sciences for "integrating climate change into long-run macroeconomic analysis." *All Nobel Prizes*, THE NOBEL PRIZE (2018), https://perma.cc/8JTQ-MZWB. His scholarly contributions are captured in his book: The Climate Casino: Risk, Uncertainty, and Economics for a Warming World. *See generally* WILLIAM D. NORDHAUS, THE CLIMATE CASINO: RISK, UNCERTAINTY, AND ECONOMICS FOR A WARMING WORLD (2015). *See also Paul Romer and William Nordhaus win the economics Nobel*, THE ECONOMIST (Oct. 13, 2018), https://perma.cc/A2JA-M8KP*;* and Eugene Linden, *The economics Nobel went to a guy who enabled climate change denial and delay*, L.A. TIMES (Oct. 25, 2018), https://perma.cc/S6GK-CZZU. His book entitled "The Climate Casino: Risk, Uncertainty, and Economics for a Warming World" states "The problem is that those who produce the emissions do not pay for that privilege, and those who are harmed are not compensated." *See* NORDHAUS, *supra*.

4. "Climate Resilience in all Policies" is conceived first here to capture the increasing realization that the underpinnings of resilience to the advanced impacts of climate change at the population level must go beyond the specific determinants of climate change and maladaptation to the projected changes. Resilience is affected by cross-cutting policies embedded in a wide range of societal sectors including: environmental management; infrastructure and manufacturing; finance; public health; transportation; housing; agriculture; and education. This approach is more specific than the "Health in all Policies" and the proposed "Environment in all Policies" strategies and will build on the lessons learned from those initiatives. *See* Geoffrey R. Browne & Ian D. Rutherford, *The Case for "Environment in All Policies": Lessons from the "Health in All Policies" Approach in Public Health*, 125 Envtl. HEALTH PERSPS. 149, n.2 (2017).

5. California Department of Toxic Substances Control - Final Regulations: Safer Consumer Product Regulations - DTSC Reference Number: R-2011-02; OAL Reference Number: Z-2012-0717-04. The OAL approval date: 08/28/13; Secretary of State Filing Date: 08/28/13; Effective Date: 10/01/13. *See Safer Consumer Product Regulations*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, https://perma.cc/9ANH-Z3AK (last visited Nov. 10, 2018) (effective Oct. 1, 2013).

with subjective weighting of potential impacts.[6] The passage of time and acquisition of new data may modify the weight assigned to different adverse impacts on human health and environmental quality. Therefore, integrating open-ended assessments into policy decisions can prevent the impasse and controversies about trade-offs. Adoption of flexible action frames, through which new scientific information is used to inform local perspectives and design alternative methodologies in comparative risk assessment, will increase the level of institutional and scientific credibility claimed by each side of risk and benefit trade-offs.[7]

Legitimization of Green Chemistry

The general public is increasingly confronted with the difficult process of making decisions at the point of purchase about paying extra for consumer products advertised as "greener," "toxics-free," "climate-friendly," or "regulation-compliant" in comparison to usually cheaper alternatives available for purchase on the same store shelf. Typically, product labels do not contain sufficient information about the presence or absence of potentially toxic chemicals or details about their impacts on human health and the environment to support the decision that consumers must make. Moreover, it is difficult to ascertain if the cost differential between functionally identical products is associated with the value of

6. Stefanie Hellweg and Llorenç Milà i Canals, *Emerging approaches, challenges and opportunities in life cycle assessment*, 344 SCI. 1109, (2014). For specific applications *see* D.A. Eisenberg et al., *Comparative alternative materials assessment to screen toxicity hazards in the life cycle of CIGS thin film photovoltaics*, 260 J. HAZARDOUS MATERIALS 534, (2013).

7. For in-depth discussion of the role of framing in policy disagreements, *see* DONALD SCHON & MARTIN REIN, FRAME REFLECTION: TOWARDS THE RESOLUTION OF INTRACTABLE POLICY CONTROVERSIES 3–58 (1994). In their constructivist approach, the authors sought to understand how scientists and policy makers make the normative leap from findings of fact to policy recommendations. Frames are considered implicit assumptions based on generative metaphors. Policy discords are presented as frame conflicts that are subject to reflective communication in policy discourse. Environmental challenges are framed in specific policy or legislative situations that may be influenced by institutional frames characterized by political mandate and system of beliefs, subject, in turn to metacultural frames organized around generative metaphors including the oppositional pairing of "risky and safe," "cause and effect", "global and local". For example, the concept of frame reflection has been used to analyze the challenges of integrating local solutions into concerns about global environmental change regarding preparedness of the health sector to adapt to climate change. Oladale A. Ogunseitan, *Framing environmental change in Africa: Cross-scale institutional constraints on progressing from rhetoric to action against vulnerability*, 13 GLOBAL ENVTL. CHANGE 101, (2003); *see also* D.B.K. Dovie et al., *Sensitivity of health sector indicators' response to climate change in Ghana*, 574 SCI. OF THE TOTAL ENV'T 837, (2017).

manufacturing materials, a premium for the disproportionate market share of "environmentally friendly" products, or an investment that a discerning consumer makes to prevent succumbing to disease, improving environmental quality, sustainability of natural resources, or climate resilience.[8]

The California economy is largely fueled by chemicals, many of them toxic to people.[9] The conventional approach to managing these chemicals takes the use of toxic materials as a given, then seeks to mitigate their harmful impacts through exposure controls. A new approach is emerging: instead of trying to control toxic chemicals, it seeks to avoid their use altogether. It imagines a world in which chemical companies formulate compounds to be both effective and safe, where consumer product manufacturers select ingredients based on their health and environmental performance, and where workers on farms, in nail salons, at airports, and in industrial plants will not have to choose between their health and their jobs.[10]

To address the ineffective outcomes of piecemeal regulation to reduce environmental and human health effects of toxic substances in consumer products, the State of California took landmark steps by passing two laws to initiate implementation of a green chemistry framework. The first law (AB 1879)[11] led to the establishment of the landmark Safer Consumer

8. It is arguable that product manufacturers prioritize consideration for the cost and performance of materials in selecting chemicals, materials, and energy resources over concerns about environmental sustainability, particularly where extended product responsibility is not codified into regulatory policies. Attempts to modify this perspective have stimulated the development of methods for life cycle analysis (LCA) which typically includes evaluations of the impacts that potent and latent toxic emissions due to material use and disposal have on human and environmental health. *See* Oladele A. Ogunseitan & Julie M. Schoenung, *Human health and ecotoxicological considerations in materials selection for sustainable product development*, 37 MATERIALS RES. SOC'Y-BULL. 356, (2012).

9. U.S. BUREAU OF ECONOMIC ANALYSIS, GROSS DOMESTIC PRODUCT (GDP) BY STATE: CALIFORNIA, https://perma.cc/R4GS-XN2B (last visited Mar. 30, 2019).

10. Gina Solomon et al., *California's green chemistry initiative at age 10: An evaluation of its progress and promise*. PUBLIC HEALTH INSTITUTE (Oct. 2018), https://perma.cc/HD2T-925K.

11. California Assembly Bill 1879 (Feuer, Chapter 559, Statutes of 2008) introduced by Assembly members Mike Feuer and Jared Huffman requires the California Department of Toxic Substances Control by January 1, 2011, to establish a process through which chemicals or chemical ingredients in consumer products may be identified and prioritized for consideration as being chemicals of concern. The designation as a chemical of concern includes a multimedia life cycle assessment, and evaluation of potential alternatives to determine the best strategy for limiting toxic exposure posed by chemicals of concern. *See* A.B. 1879 (Cal. 2008).

Products program (SCP)[12] through which the California Department of Toxic Substances Control (DTSC) identifies and prioritizes chemicals of concern in consumer products made and/or sold in the State.[13] The law also requires DTSC to develop methods for analyzing alternatives to existing hazardous chemicals to avoid regrettable substitutions.[14] The second law, SB 509[15] directs DTSC to establish a Toxics Information Clearinghouse. This includes five categories of information about chemicals known or suspected to be hazardous, namely: 1) physical-chemical characteristics; 2) exposure pathways; 3) toxicological and other public health impacts; 4) environmental and ecological effects; and 5) regulatory policies.[16] The goal is to increase public knowledge about the potential hazards associated with numerous chemicals used in California.

The historic Safer Consumer Products Regulations require "manufacturers or other responsible entities to seek safer alternatives to harmful chemical ingredients in widely used products, offering California the opportunity to lead the way in producing safer versions of goods already in demand worldwide."[17] The California Office of Administrative Law

12. The California Safer Consumer Products program uses a "four-step process to reduce toxic chemicals in the products that consumers buy and use. It identifies specific products that contain potentially harmful chemicals and asks manufacturers to answer two questions: 1) Is this chemical necessary? 2) Is there a safer alternative?" *See Safer Consumer Products Program*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, https://perma.cc/LLV4-EMDX (last visited Oct. 8, 2018).

13. *See Candidate Chemicals List*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, https://perma.cc/A8EK-8Q6Y (last visited Nov. 10, 2018).

14. *See Alternatives Analysis*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, https://perma.cc/YX25-8QEJ (last visited Nov. 10, 2018).

15. S.B. 509 (Cal. 2008). SB 509 became effective following enactment of AB 1879 (Simitian, Chapter 560, Statutes of 2008), thereby requiring California DTSC to establish a "Toxics Information Clearinghouse for the collection, maintenance, and distribution of specific chemical hazard traits and environmental and toxicological end-point data." The California Office of Environmental Health Hazard Assessment (OEHHA) is required to evaluate and specify the hazard traits and environmental and toxicological end-points and any other relevant data that are to be included in the clearinghouse.

16. *See Toxics Information Clearinghouse*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, https://perma.cc/25NW-H8HW (last visited Nov. 10, 2018).

17. According to California DTSC, the Safer Consumer Products regulations advance environmental protection laws by shifting from "end-of-pipeline" clean-up of hazardous pollution to "cradle-to—gave" regulation that encourages design to prevent harm, promoting innovation and market incentives toward a sustainable economy. *See generally Safer Consumer Products: final Statement of Reasons*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, https://perma.cc/7ECV-ZDKM (last visited Feb. 10, 2019). New environmental challenges associated with recalcitrant products such as plastics in the ocean have rekindled

approved the regulations on August 28, 2013, almost exactly five years after the two legislative bills on the California Green Chemistry Initiative were signed into law by then Governor Arnold Schwarzenegger.[18] The delay in implementation was due to numerous controversies about the scope of the law, the projected economic impacts on consumers and manufacturers, and the scientific basis of alternative material assessments.[19] The law established an expert panel entitled the "Green Ribbon Science Panel" (GRSP) to guide the State through these controversies.[20] The twenty-seven inaugural GRSP members met from 2009 and 2013, to discuss perspectives from academic researchers, manufacturing corporations, consumer advocacy groups, and consulting firms to represent twenty-four legislatively-designated disciplines.[21] The California law is seminal in its explicit translation of the new scientific paradigm of green chemistry into policy and will continue to serve as a template for similar initiatives in other regions of the U.S. and in different

efforts to adopt a reuse and recycle emphasis on "cradle-to-cradle" regulations rather than "cradle-to-grave." *Id.*

18. Green chemistry is simply defined as the "design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances." A frequently lauded example of green chemistry is the metathesis methods in organic chemical synthesis, for which Yves Chauvin, Robert Grubbs, and Richard Schrock were awarded the 2005 Nobel Prize in Chemistry. Green chemistry attributes of metathesis methods include having fewer reaction steps, fewer resources required, less wastage, procedural stability at normal temperatures and pressures, and avoidance of injurious solvents. For California's take on green chemistry, *see Green Chemistry Resources*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, https://perma.cc/HP57-K8QT (last visited Feb. 10, 2019).

19. It has been argued that the lessons learned from the California process of transforming the green chemistry initiative into enforceable law has not informed federal initiatives to promote the invention of new materials to satisfy manufacturing demands. For example, President Obama's "Materials Genome Initiative" aimed to more rapidly meet societal needs in clean energy, national security, and human welfare by developing materials that are "at the heart of innovation, economic opportunities, and global competitiveness". However, the initiative missed an opportunity to embed sustainability principles into material inventions: sustainable materials intended for use in mass-marketed products must not threaten environmental quality and human health through their production, use, or disposal. *See* Oladele A. Ogunseitan et al., *Translating the materials genome into safer consumer products*, 47 ENVTL. SCI. & TECH. 12625 (2013).

20. The California Green Ribbon Science Panel currently consists of 15 members, including two co-chairs, with various expertise necessary to advises the Department of Toxic Substances Control on topics related to Green Chemistry, such as the implementation of the Safer Consumer Products regulations. *See Former Panel Members*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, https://perma.cc/VQ82-AZ8V (last visited Feb. 10, 2019).

21. *Green Ribbon Science Panel*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, https://perma.cc/4A8L-ELW5 (last visited Nov. 10, 2018).

parts of the world.[22] The interdisciplinary perspectives and public commentary solicited to guide the law also provided rich material for unique case studies that are being expatiated and documented. In the following sections, I present two cases where consideration of trade-offs for potential benefits of toxic chemicals—in the context of climate change—have exempted those chemicals from broad policies to control chemical exposures and prevent harm to human health and the environment.

Toxic Mercury in Energy-Efficient Lighting Equipment

The final report of the California Green Chemistry Initiative (GCI) published in December 2008 stated categorically that "[g]reen chemists are developing lighting that contains no mercury or other toxic materials and is 50 times more energy efficient than the fluorescent light bulb."[23] The first set of regulations emanating from the California GCI exempted mercury-containing fluorescent light bulbs to avoid conflict with the commitment to address climate change through phasing out energy-intensive incandescent light bulbs. California DTSC's response to fluorescent lights acknowledges the risks associated with mercury toxicity, but also proclaims their energy efficiency and role in reducing greenhouse gases that contribute to global

22. Sheila A. Millar & Anushka N. Rahman, *Green Chemistry in 2017: The State of the States*, KELLER & HECMAN LLP (May 16, 2017), https://perma.cc/6UW6-CH3S.

23. California Green Chemistry Initiative—Final Report, December 2008. State of California—Arnold Schwarzenegger, Governor; California Environmental Protection Agency, Linda Adams, Secretary; Department of Toxic Substances Control, Maureen Gorsen, Director. The California Green Chemistry Initiative made six far-reaching recommendations: i) Expand Pollution Prevention and product stewardship programs to more business sectors to refocus additional resources on prevention rather than clean up; ii) Develop Green Chemistry Workforce Education and Training, Research and Development and Technology Transfer through new and existing educational programs and partnerships; iii) Create an Online Product Ingredient Network to disclose chemical ingredients for products sold in California, while protecting trade secrets; iv) Create an Online Toxics Clearinghouse, an online database of chemical toxicity and hazards populated with the guidance of a Green Ribbon Science Panel to help prioritize chemicals of concern and data needs; v) Accelerate the Quest for Safer Products, creating a systematic, science-based process to evaluate chemicals of concern and alternatives to ensure product safety and reduce or eliminate the need for chemical-by-chemical bans; and vi) Move Toward a Cradle-to-Cradle Economy to leverage market forces to produce products that are "benign-by-design" in part by establishing a California Green Products Registry to develop green metrics and tools (e.g., environmental footprint calculators, sustainability indices) for a range of consumer products and encourage their use by businesses. *See* STATE OF CALIFORNIA, CALIFORNIA GREEN CHEMISTRY INITIATIVE-FINAL REPORT (2018), https://perma.cc/M2Q5-UMLB.

climate change. Fluorescent lights are able to accomplish this climate-saving function because they contain small amounts of mercury.[24]

The argument for exempting mercury is that using energy-efficient fluorescent bulbs instead of incandescent bulbs reduces demand for electricity, which in turn reduces the amount of coal burned by power plants that account for more than 40 percent of all mercury emissions from anthropogenic sources.[25] However, this argument has been upended recently by President Trump's public support for rejuvenating the coal

24. *Fluorescent Lights*, CAL. DEP'T OF TOXIC SUBSTANCES CONTROL, https://perma.cc/GHY6-FPSL (last visited Oct. 9, 2018). In California, mercury-containing fluorescent lights are prohibited from disposal with domestic waste and are managed as Universal Wastes. The U.S. Environmental Protection Agency estimates that the average compact fluorescent light bulb contains ~4mg of mercury sealed within the glass tubing, although estimates of mercury measured in lamp waste streams can be much higher depending on date of manufacture of the original product.

25. Section 2.7 of the 2014 National Emissions Inventory, version 1 (Dec. 2016) of the Technical Support Document. *See 2014 National Emissions Inventory*, EPA, https://perma.cc/LFD2-NF3G (last visited Oct. 13, 2018).

industry[26, 27], cancelation of federal policies to curb industrial pollution,[28] and withdrawal from the Paris Accord on Climate Change.[29]

26. *See* Exec. Order No. 13783, 82 Fed. Reg. 16,093 (Mar. 31, 2017). The order explicitly reverses Obama era limitations on the coal industry: "Sec. 6. Federal Land Coal Leasing Moratorium. The Secretary of the Interior shall take all steps necessary and appropriate to amend or withdraw Secretary's Order 3338 dated January 15, 2016 (Discretionary Programmatic Environmental Impact Statement (PEIS) to Modernize the Federal Coal Program), and to lift any and all moratoria on Federal land coal leasing activities related to Order 3338. The Secretary shall commence Federal coal leasing activities consistent with all applicable laws and regulations." *Id.*

27. *See* UNITED STATES PRESIDENTIAL PROCLAMATION 9794, NATIONAL ENERGY AWARENESS MONTH 2018 (SEP. 28, 2018), https://perma.cc/2EC3-EUR6. "The American energy renaissance is pressing forward with stunning speed. The United States is becoming both energy independent and energy dominant because of the entrepreneurial spirit of the American people and the application of innovative technologies to energy production, transmission, distribution, and use. Recently, United States crude oil production rose to roughly 11 million barrels a day, making our Nation the largest global producer. Additionally, the United States is the world's largest producer of natural gas, and, in 2017, **our coal exports rose by roughly 60 percent over the previous year.** American energy dominance means the end of our crippling dependence on foreign energy, and that our industries have access to reliable, affordable, and diverse energy supplies that enable them to compete in the global marketplace. Increasing energy security is also ushering in a new era of American leadership around the world as we export more of our energy bounty to friends and allies abroad, freeing them from hostile dependence." *Id.*

28. *See* Exec. Order No. 13771, 82 Fed. Reg. 9,339 (Feb. 3, 2017). "Section 1. Purpose. It is the policy of the executive branch to be prudent and financially responsible in the expenditure of funds, from both public and private sources. In addition to the management of the direct expenditure of taxpayer dollars through the budgeting process, it is essential to manage the costs associated with the governmental imposition of private expenditures required to comply with Federal regulations. Toward that end, it is important that **for every one new regulation issued, at least two prior regulations be identified for elimination**, and that the cost of planned regulations be prudently managed and controlled through a budgeting process." *Id.*

29. Exec. Order 13783, *supra* n.24. (a) **The following Presidential actions are hereby revoked**: (i) Executive Order 13653 of November 1, 2013 (**Preparing the United States for the Impacts of Climate Change**); (ii) The Presidential Memorandum of June 25, 2013 (Power Sector Carbon Pollution Standards); (iii) The Presidential Memorandum of November 3, 2015 (Mitigating Impacts on Natural Resources from Development and Encouraging Related Private Investment); and (iv) The Presidential Memorandum of September 21, 2016 (Climate Change and National Security). (b) The following reports shall be rescinded: (i) The Report of the Executive Office of the President of June 2013 (The President's Climate Action Plan); and (ii) The Report of the Executive Office of the President of March 2014 (Climate Action Plan Strategy to Reduce Methane Emissions). (c) The Council on Environmental Quality shall rescind its final guidance entitled "Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews," which is referred to in "Notice of Availability," 81 Fed. Reg. 51866 (August 5, 2016)."

The exemption or adoption of mild regulatory policies regarding mercury in green chemistry legislation is not limited to California and may be one of few instances whereby the progressive state policy aligns with federal policy in international conventions. The United Nation's Minamata Convention on Mercury[30] is a landmark international treaty that aims to limit the human health and environmental damages from anthropogenic sources of mercury. Despite the broad scope of the Minamata Convention to curb mercury exposure, Article-6 of the convention includes loop-holes characterized as "exemptions."[31] Annex-A of the Minamata Convention lists mercury-added products that are affected by the terms of the treaty, including compact fluorescent lamps (CFLs) for general lighting purposes that are 30 watts or less with a mercury content exceeding 5mg per lamp burner; linear fluorescent lamps (LFLs) for general lighting purposes such as triband phosphor less than 60 watts with a mercury content exceeding 5mg per lamp, and halophosphate phosphor less than or equal to 40 watts with a mercury content exceeding 10mg per lamp; high pressure mercury vapor lamps (HPMV) for general lighting purposes, and mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for electronic displays, including short length (less than or equal to 500 mm) with mercury content exceeding 3.5mg per lamp, medium length (between 500 mm and 1,500 mm) with mercury content exceeding 5 mg per lamp, and long length (longer than 1,500 mm) with mercury

30. *See* generally, *The Minamata Convention Text*, United Nations Env't Programme (2013), https://perma.cc/7RKZ-VLHU. The U.S. was the first to ratify the United Nations Environment Program's Minamata Convention on Mercury, which aims to protect human health and the environment from the adverse effects of mercury. The Convention entered into force on 16 August 2017, on the 90th day after the date of deposit of the 50th instrument of ratification, acceptance, approval or accession. The Convention highlights the pervasive threats of mercury pollution that occurs through widespread use in everyday objects, including thermometers, dental amalgam, thermostats and light switches. Mercury is released to the environment from these sources, as well as from industrial sources such as energy generation from coal burning. sources. Minamata Convention bans new mercury mines, and phases-out existing mines, in addition to phasing out (or phase down) of mercury use in several products and processes, including artisanal and small-scale gold mining.

31. *The Minamata Convention Text*, UNITED NATIONS ENV'T PROGRAMME (2013), https://perma.cc/7RKZ-VLHU, at 22-23. Exemptions available to a Party upon request: 1. Any State or regional economic integration organization may register for "one or more exemptions from the phase-out dates listed in Annex A and Annex B, including cases of any mercury-added product that is added by an amendment to Annex A or any manufacturing process in which mercury is used that is added by an amendment to Annex B, no later than the date upon which the applicable amendment enters into force for the Party."

content exceeding 13mg per lamp.[32] These were to be phased out by the year 2020.[33]

Citing the voluntary "Energy Star" program,[34] the United States filed notification under the Minamata Convention on Mercury that several products already meet the *de minimis* mercury concentration in eight of the nine product categories scheduled to be phased out by 2020, implying that no further action is needed to comply.[35] These products include: batteries; compact fluorescent lamps; linear fluorescent lamps; high pressure mercury vapor lamps; cold cathode fluorescent lamps; and external electrode fluorescent lamps.[36] Each fluorescent lamp in circulation contains 3mg to 46mg of mercury depending on the year of manufacture, and we can expect mercury-laden lamps to continue entering the hazardous and domestic waste stream for decades.[37] Mercury is the only chemical named specifically in the overhaul of the Toxic Substances Control Act under the 2016 Frank R. Lautenberg Chemical Safety for the 21st Century Act.[38,39]

The trade-offs in dealing with climate change through energy conservation while also allowing the use of toxic mercury in widespread consumer products is a major challenge for strategies to gain credibility for

32. *The Minamata Convention Text*, UNITED NATIONS ENV'T PROGRAMME 22 (2013), https://perma.cc/7RKZ-VLHU.

33. *Id.*

34. The Energy Star program is a voluntary U.S. Environmental Protection Agency-run incentive to support businesses and individuals save money and protect climate through superior energy efficiency. *See* ENERGY STAR, https://perma.cc/VA6F-HLBP (last visited Oct. 13, 2018).

35. *Exemptions under the Minamata Convention on Mercury*, UNITED NATIONS ENV'T PROGRAMME, (2013), https://perma.cc/5T3B-M3TM.

36. United States of America Notification Under Article 4, Paragraph 2, of Information on Domestic Measures and Strategies Implemented to Address Mercury-Added Products, Including those in Part I of Annex A to the Minamata Convention on Mercury. *See Notification Under the Minamata Convention*, UNITED NATIONS ENV'T PROGRAMME, (2013), https://perma.cc/EB9W-H4KR (Oct. 13, 2018).

37. S.R. Lim et al., *Potential environmental impacts from the metals in incandescent, compact fluorescent lamp (CFL), and light-emitting diode (LED) bulbs*, 47 ENVTL. SCI. & TECH. 1040–47 (2012).

38. Janet Wilson & Oladele A. Ogunseitan, *A Call for Better Toxics Policy Reform*, 59 ENV'T: SCI. AND POL'Y FOR SUSTAINABLE DEV. 30, 33 (2017).

39. Oladele A. Ogunseitan, *Mercury Safety Reform in the 21st Century: Advancing the New Framework for Toxic Substances Control*, 59 ENV'T: SCI. AND POL'Y FOR SUSTAINABLE DEV., Jul.-Aug. 2017, at 3.

climate resilience across all societal sectors.[40] The contention about how best to account for the trade-offs in the assessment of mercury as a dangerous pollutant and the cost of climate change mitigation assigned to corporations became intensified in December 2018, when the Acting U.S. EPA Administrator, Andrew R. Wheeler, decided to reconsider the supplemental finding and residual risk and technology review of the "National Emission Standards for Hazardous Air Pollutants: Coal-and Oil-Fired Electric Utility Steam Generating Units (commonly known as the Mercury and Air Toxics Standards (MATS))"[41] This revision challenges the U.S. Supreme Court's decision in *Michigan v. EPA* which held that the EPA erred by not considering economic cost in its determination that regulation under section 112 of the Clean Air Act (CAA) of hazardous air pollutant (HAP) emissions from coal- and oil-fired electric utility steam generating units (EGUs) is appropriate and necessary.[42] The EPA action proposes to conclude that the Supplemental Finding was flawed because the costs of mercury pollution to population health is "negligible" compared to the cost of retrofitting coal-fired power plants to reduce hazardous emissions.[43] However, if the co-benefits of regulating mercury are included (for example, reduction in emissions of particulate matter), the health benefits of the mercury regulation far out-weigh the costs to industry. Moreover, many coal-fired electricity generators have already spent money to retrofit their factories, but if the regulatory standards for mercury emissions are dismissed, it is conceivable that many factories will chose not to bear the cost of maintaining the equipment installed to reduce mercury pollution.[44] Thus, the EPA contended that after considering the cost of compliance relative to the HAP benefits of MATS, it is not appropriate and necessary to regulate coal- and oil-fired EGUs under

40. SAN FRANCISCO DEPARTMENT OF PUBLIC HEALTH, ASSESSING THE HEALTH CO-BENEFITS OF SAN FRANCISCO'S CLIMATE ACTION PLAN 14–16, https://perma.cc/T6ER-WBWT.

41. National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units—Reconsideration of Supplemental Finding and Residual Risk and Technology Review, 40 C.F.R. 63 (Dec. 27, 2018), https://perma.cc/4RQC-365Q.

42. *Clean Air Act—Cost Benefit Analysis—Michigan v. EPA*, 129 HARVARD L. REV., 311, 311–320 (2015), https://perma.cc/5MEH-84WN.

43. ENVIROMENTAL PROTECTION AGENCY, EPA-HQ-OAR-2009-0234, EPA'S RESPONSES TO PUBLIC COMMENTS ON EPA'S NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FROM COAL- AND OIL-FIRED ELECTRIC UTILITY STEAM GENERATING UNITS—VOLUME 1, pp. 29, 33, 67, 190, 262 (Dec. 2011), https://perma.cc/R68E-YMBW.

44. U.S. ENERGY INFORMATION ADMINISTRATION, COAL PLANTS INSTALLED MERCURY CONTROLS TO MEET COMPLIANCE DEADLINES (Sept. 18, 2017), https://perma.cc/SJ7A-7BXA.

section 112 of the CAA.[45] It is very likely that the EPA's new argument to disregard mercury emissions from coal burning will be challenged all the way to the Supreme Court.

Toxic Pesticides and Climate-Sensitive Diseases

Malaria is the frontline disease for investigating the projected impacts of climate change on human health.[46] Yet, the connection between malaria control and climate is very controversial and remains unsettled. The Intergovernmental Panel on Climate Change (IPCC) Working Group II's reports on potential impacts of climate change have included human health considerations, but the emphasis on disease vulnerability for different regions has evolved with improved scientific understanding.[47] The IPCC assessment of the vulnerability of human health to climate change emerged from a background of potentially "widespread increase in new and resurgent vector-borne and infectious diseases, such as dengue, malaria, hantavirus and cholera."[48] The only numerical projection included in the early IPCC assessments relates to the expansion of the geographical zone of malaria in response to global mean temperature at the upper part of the IPCC-projected range (3–5°C increase in global average temperature by the year 2100).[49] Hence, the proportion of human population affected by malaria was expected to increase from 45% to 60%. This meant that an additional 2 billion people, mostly in the temperate Northern Hemisphere could become vulnerable to malaria infection by mid-century, based on the early Global Burden of Disease assessments coordinated by the World

45. *See generally* Maribeth Hunsinger, *Interpreting "Appropriate and Necessary" Reasonably under the Clean Air Act: Michigan v. Environmental Protection Agency*, 44 ECOLOGY L. Q. 535 (2017), https://perma.cc/5EUL-J2Q2, at 536.

46. *See generally* ROLLBACK MALARIA PARTNERSHIP, LESSONS LEARNED FROM RESPONDING TO MALARIA GLOBALLY: A PROTOTYPE FOR SUSTANIABLE DEVELOPMENT, FACTSHEET ON MALARIA AND THE SDGS, https://perma.cc/FLD7-M9GE; s*ee also* THE WORLD HEALTH ORGANIZATION, CLIMATE CHANGE AND INFECTIOUS DISEASES, https://perma.cc/EU5V-BPV7.

47. *See generally* IPCC, CLIMATE CHANGE 2014: SYNTHESIS REPORT. CONTRIBUTION OF WORKING GROUPS I, II AND III TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2014).

48. ROBERT WATSON ET AL., EDS, THE REGIONAL IMPACTS OF CLIMATE CHANGE: AN ASSESSMENT OF VULNERABILITY. SUMMARY FOR POLICYMAKERS. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 5 (1997).

49. IPCC, PROJECTIONS OF FUTURE CLIMATE CHANGE (2018).

Health Organization.[50] In areas where malaria is currently endemic, mostly in the humid tropical zones of Africa, a 10% increase in the annual number of malaria cases was expected from the estimated 500 million cases.[51, 52] The IPCC assessment concluded that, in general, Africa is the continent most vulnerable to the impacts of projected climate change because prevalent poverty limits adaptation capabilities.[53, 54] In the health sector, Africa is expected to be at risk primarily from increases in vector-borne diseases, and because of the huge economic burden of diseases, IPCC suggested that global efforts would be needed to tackle the potential health effects of climate change.[55]

Twenty years after the initial assessment reports, it has turned out that the connection between malaria epidemiology and climate change is complicated and that simplistic projection based on temperature and precipitation are not as informative as once thought.[56, 57] Malaria remains the world's most burdensome mosquito-borne parasitic disease, killing half a million people and sickening a quarter of a billion

50. THE GLOBAL BURDEN OF DISEASE: A COMPREHENSIVE ASSESSMENT OF MORTALITY AND DISABILITY FROM DISEASES, INJURIES, AND RISK FACTORS IN 1990 AND PROJECTED TO 2020 18–19 (Christopher J. L. Murray & Alan D. Lopez eds., 1996).

51. Cyril Caminade, et al. "Impact of climate change on global malaria distribution." Proceedings of the National Academy of Sciences 111.9 (2014): 3286–3291.

52. Oladele A. Ogunseitan, *Framing Environmental Change in Africa: Cross-Scale Institutional Constraints on Progressing From Rhetoric to Action Against Vulnerability*, 13 GLOBAL ENVTL. CHANGE 101 (2003).

53. ISABELLE NIANG ET AL., 2014:AFRICA. IN: CLIMATE CHANGE 2014: IMPACTS, ADAPTATION, AND VULNERABILITY. PART B: REGIONAL ASPECTS. CONTRIBUTION OF WORKING GROUP II TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE p. 1205 (2014), https://perma.cc/7XQZ-AM5R.

54. Eve Worrall et al., *Is Malaria A Disease of Poverty? A Review of The Literature*, 10 TROPICAL MED. & INT'L HEALTH 1047(2005).

55. *See* IPCC, CLIMATE CHANGE 2014: IMPACTS, ADAPTATION, AND VULNERABILITY, PART A: GLOBAL AND SECTORAL ASPECTS (Cambridge University Press, 2014), https://perma.cc/5367-YH6V.

56. Delali B.K. Dovie et al., *Sensitivity of Health Sector Indicators' Response to Climate Change in Ghana*, 574 SCI. OF THE TOTAL ENV'T. 837, 843 (2017).

57. *Climate Change and Malaria: A Complex Relationship*, UNITED NATIONS CHRONICLE (2010) (accessed Oct. 13, 2018), https://perma.cc/LE72-8KAU.

more every year.[58] But recent experience with Zika,[59] Dengue,[60] and other mosquito borne diseases have heightened the salience of climate-sensitive diseases and the need to build climate resilience as a "no-cost-adaptation" strategy for malaria-endemic countries. One of the complications of the climate context of malaria is the intervention with toxic pesticides such as dichlorodiphenyltrichloroethane (DDT).[61] Historically, malaria was endemic in the southeastern United States, and the origin of the U.S. Centers for Disease Control and Prevention (CDC) is linked to the Office of Malaria Control in War Areas, which was established in 1942 to reduce the impact of malaria in that region of the U.S. during the second World War.[62] DDT was used extensively in the U.S. during this "war on malaria" period and has been used in many other countries to aid the eradication of malaria.[63]

The publication of Rachel Carson's book, "Silent Spring" called into question the indiscriminate spraying of recalcitrant and toxic chemicals such as DDT,[64] and the debate about the trade-offs between malaria control and toxic pesticide effects continues today.[65] The United Nation's Stockholm Convention on Persistent Organic Pollutants includes DDT in the list of "chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects

58. *Malaria*, WORLD HEALTH ORGANIZATION, https://perma.cc/2LRV-HMYE (last visited Oct. 13, 2018).

59. *Zika Virus*, WORLD HEALTH ORGANIZATION, https://perma.cc/XMR5-CFG2 (last visited Oct. 13, 2018).

60. *Dengue Control*, WORLD HEALTH ORGANIZATION, https://perma.cc/KZH3-RQTD (last visited Oct. 13, 2018).

61. Henk Van Den Berg et al., *Global Trends in The Production And Use of DDT for Control of Malaria and Other Vector-Borne Diseases*, 16 MALARIA J. 401, 405–6 (2017).

62. *CDC's Origin and Malaria*, CENTERS FOR DISEASE CONTROL AND PREVENTION, https://perma.cc/7YVZ-CZGP (last visited Oct. 13, 2018).

63. Uriel Kitron & Andrew Spielman, *Suppression of Transmission of Malaria Through Source Reduction: Antianopheline Measures Applied in Israel, The United States, And Italy*, 11 REVIEWS OF INFECTIOUS DISEASES 391 (1989) at 5.

64 RACHEL CARSON, SILENT SPRING (Mariner Books 1st ed. 2003).

65. Clyde Haberman, *Rachel Carson, DDT and the Fight Against Malaria* N.Y. TIMES (Jan. 22, 2017), https://perma.cc/K8A5-LACJ; WORLD HEALTH ORGANIZATION, *The use of DDT in malaria vector control: WHO position statement* (2011), https://perma.cc/T3GK-V8LH.

to human health and the environment,"[66, 67] for those reasons the manufacture and use of this pesticide is restricted worldwide.[68] Countries burdened with malaria have argued for the continued allowance of DDT for vector control.[69] Therefore, the Stockholm Convention exempts the production and public health use of DDT specifically for indoor application because there are no similarly effective and efficient alternatives.[70]

Active monitoring of DDT's effects in malaria control regions continue to show adverse impacts, and the trade-off becomes climate-sensitive diseases such as malaria and toxic pesticide effects—both of which remain a challenge for climate resilience strategies.[71, 72, 73, 74] DDT is not alone in the controversy regarding toxic pesticide application and climate-sensitive disease. Integrated Vector Management[75] that includes

66. BASEL CONVENTION CONTROLLING THE TRANSBOUNDARY MOVEMENT OF HAZARDOUS WASTES AND THEIR DISPOSAL, https://perma.cc/9GVC-HFVK (last visited Mar. 26, 2019).

67. STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS, UNEP, May 22, 2001. The United Nations Stockholm Convention on Persistent Organic Pollutants is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment. The Stockholm Convention on Persistent Organic Pollutants was adopted by the Conference of Plenipotentiaries on 22 May 2001 in Stockholm, Sweden. The Convention entered into force on May 17, 2004.

68. Cynthia Hardy & Steve Maguire, S., *Discourse, Field-Configuring Events, and Change in Organizations And Institutional Fields: Narratives of DDT and the Stockholm Convention*, 53 ACAD. OF MGMT. J. 1365, 1369 (2010).

69. Amir Attaran et al., *Doctoring Malaria, Badly: The Global Campaign to Ban DDT for Malaria Control Should Not be Banned Commentary: Reduction and Elimination of DDT Should Proceed Slowly*, 321 BRIT. MED. J. 1403, 1403–05 (2000).

70. Henk Van Den Berg, *Global status of DDT and its Alternatives for Use in Vector Control to Prevent Disease*, 117 ENV'L HEALTH PERSPECTIVES, 1656, 1656–63 (2009).

71. Brenda Eskenazi et al., *Prenatal Exposure to DDT and Pyrethroids for Malaria Control and Child Neurodevelopment: The VHEMBE Cohort, South Africa*, 126 ENV'L HEALTH PERSPECTIVES, Apr. 6, 2018, at 047004-1.

72. *See generally* Maria Bornman et al., *Alterations in male reproductive hormones in relation to environmental DDT exposure*, 113 ENV. INT'L 281, 281–89 (2018).

73. Steffen E. Eikenberry and Abba Gumel, *Mathematical Modeling of Climate Change and Malaria Transmission Dynamics: A Historical Review*, 77 J. OF MATHEMATICAL BIOLOGY 857 (2018).

74. Margaux L. Sadoine et al., *The Associations Between Malaria, Interventions, and the Environment: A Systematic Review and Meta-Analysis*, 17 MALARIA J.(2018).

75. *Interim CDC Recommendations for Zika Vector Control in the Continental United States*, U.S. CENTERS FOR DISEASE CONTROL AND PREVENTION, https://perma.cc/H8DZ-X9HB (last visited Oct. 13, 2018).

the application of the pesticide "Naled" (dimethyl 1,2-dibromo-2,2-dichloroethylphosphate) to control Zika virus mosquito vectors have stimulated community protests in the southeastern part of the U.S.[76, 77, 78] Since pesticides and infectious pathogens can spread beyond the point of application or disease origin to affect distant populations, it is inappropriate to decide to use toxic pesticides against climate-enabled disease outbreaks without location-specific assessment of exposure and risk. The different temporal dimensions of exposure period to symptom development also complicates the risk assessment process because the outcome of carcinogenic pesticide exposure may not become apparent for decades after the initial exposure, whereas infection with a pathogenic virus or bacteria may lead to symptoms within a few weeks.[79, 80] Further research is needed to disentangle the influences of public perceptions of risks associated with toxic chemicals compared to infectious agents, and how to integrate such perceptions with quantitative and qualitative estimates of disease burden in affected populations.

Prospective

Integrating climate resilience in all policies will require transparency about trade-offs with other more or less desirable environmental risk factors, particularly the use of toxic chemicals in energy conservation and the control of climate-sensitive vector-borne diseases. The development of methods needed to quantify the trade-offs in terms of disease burden and economic costs to societies is in rudimentary stages. When sufficiently advanced and validated, the interpretation of the outcomes of

76. "Naled is an insecticide that has been registered since 1959 for use in the United States. It is used primarily for controlling adult mosquitoes but is also used on food and feed crops and in greenhouses. For mosquito control, Naled is most commonly applied aerially as an ultra-low volume (ULV) spray. ULV sprayers mounted on planes or helicopters dispense very fine aerosol droplets containing small quantities of insecticide mixed with water that drift through the air and kill mosquitoes on contact." *Naled for Mosquito Control*, U.S. ENVTL. PROT. AGENCY, https://perma.cc/P67A-BES6 (last visited Oct. 13, 2018).

77. *Miami Beach Wary of Spraying Zika Chemical That Can "Essentially Kill Anything*," CBS NEWS (Sept. 6, 2016), https://perma.cc/J2QQ-2NJC; Richard Luscombe, *Miami Beach Protest Against use of Naled to Fight Zika-carrying Mosquitos*, THE GUARDIAN (Sept. 8, 2016), https://perma.cc/39SQ-ZFU5.

78. Thomas R. Frieden et al., *Zika virus 6 months later*, 316 J. OF THE AM. MED. ASS'N, 1443, 1443–44 (2016).

79. Diana L. Nadler & Igor G. Zurbenko, *Estimating Cancer Latency Times Using a Weibull Model*, ADVANCES IN EPIDEMIOLOGY Aug. 31, 2014, at 1.

80. Andrew Azman et al., *The Incubation Period of cholera: A Systematic Review*, 66 J. OF INFECTION 432, 432 (2013).

methodological analysis into policy formulation will also need careful study. Until then, "climate resilience in all policies" is an excellent rhetoric with an urgency to translate the words into action.[81]

81. *See generally* Susanne C. Moser & Julia A. Ekstrom, *A Framework to Diagnose Barriers to Climate Change Adaptation*, 107 PROCEEDINGS OF THE NAT'L ACAD. OF SCI. 22026 (2010); Ogunseitan, *supra* note 45, at 101–11.